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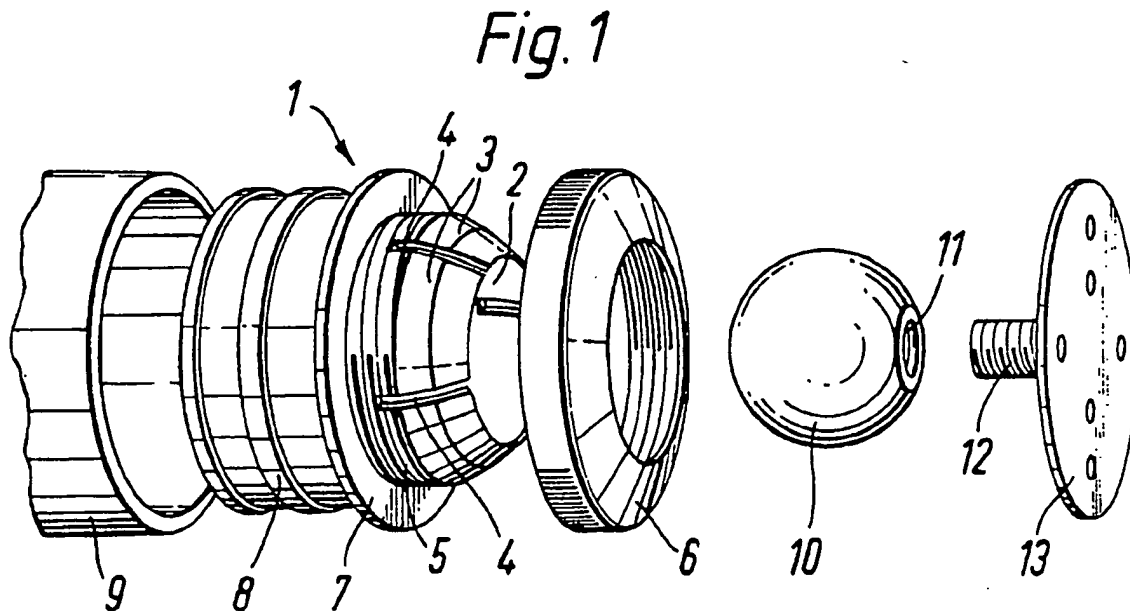
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US 4613331 A

(58) Field of Search  
UK CL (Edition M ) A5R RFA  
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ONLINE DATABASE: WPI

**(54) Prosthetic wrist**

(57) A prosthetic wrist comprises a ball and socket joint wherein the socket 2 is formed of resilient segments 3 and is shaped so that the ball 10, to which is attached a terminal device 13, is a snap-fit therein. The socket can be compressed onto the ball by means of locking ring 6 so that the friction between the ball and socket is increased until the ball is locked therein. Unscrewing the ring allows the ball to be snapped out of the socket so that the terminal device may be removed or replaced. The wrist may be used with a traditional prosthesis, a myoelectric hand or may be attached to an exoskeletal assembly. The wrist provides a full range of movement and is ideal for sporting activities.



**At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.**

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Fig. 1

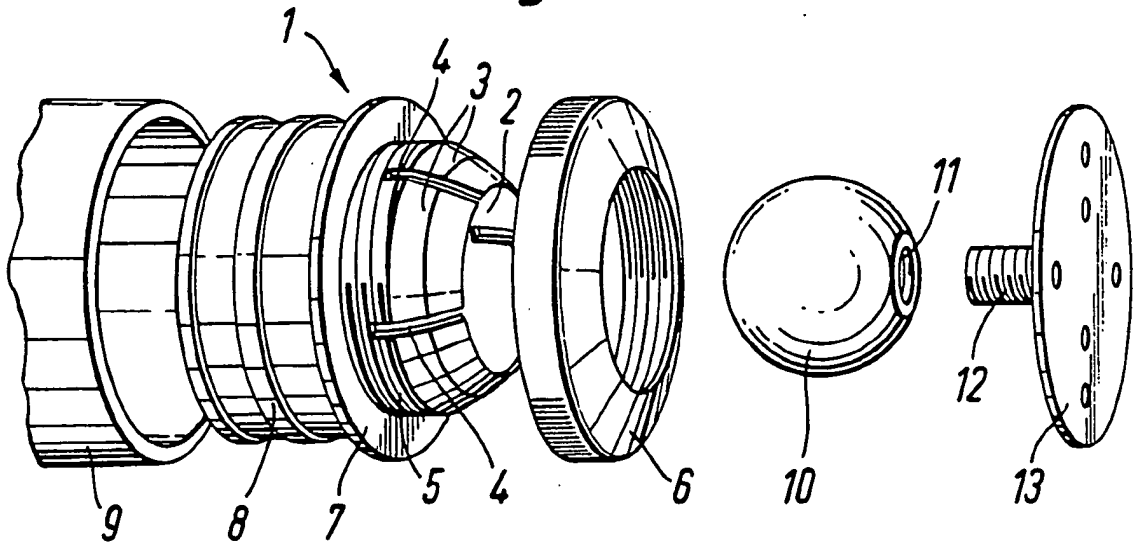


Fig. 2

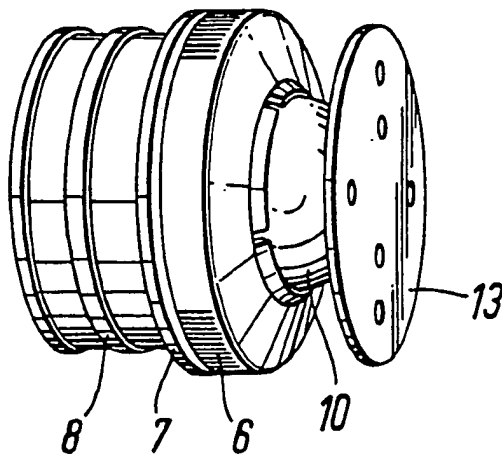


Fig. 3

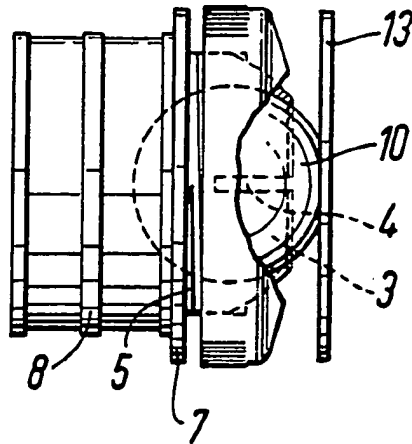
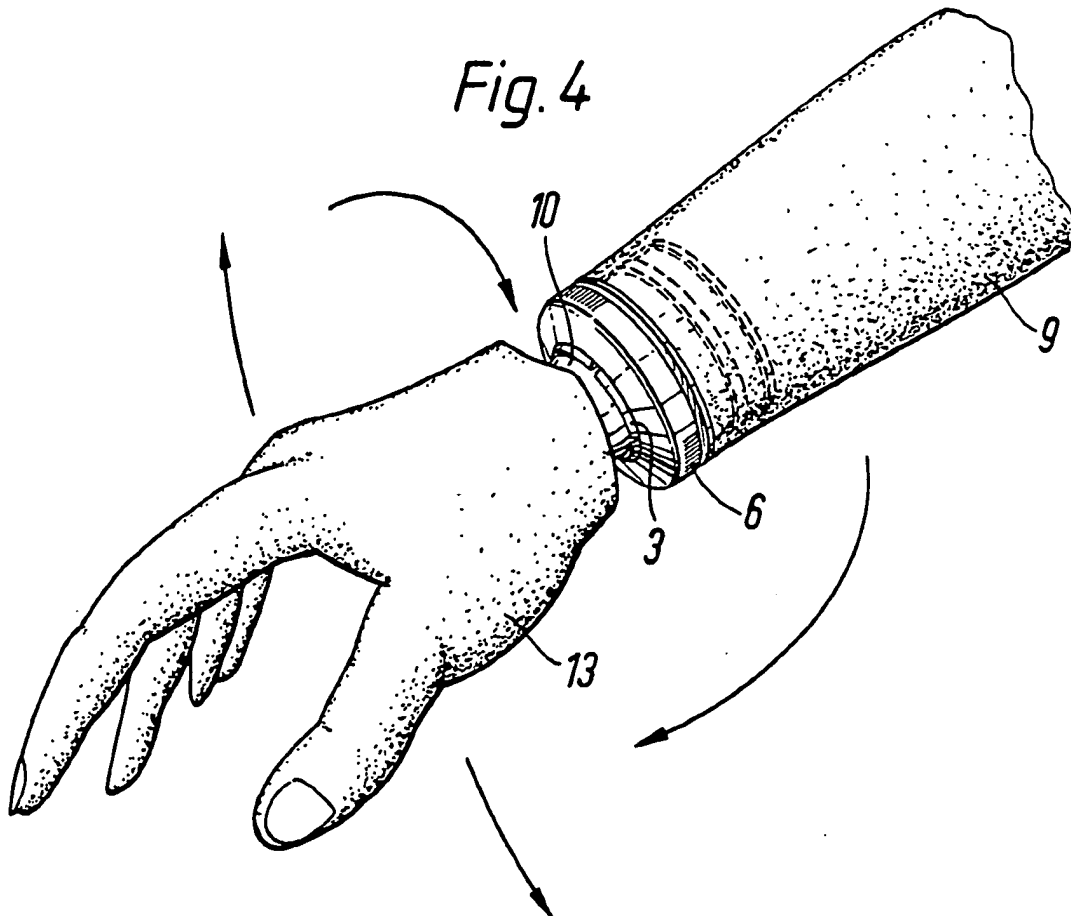
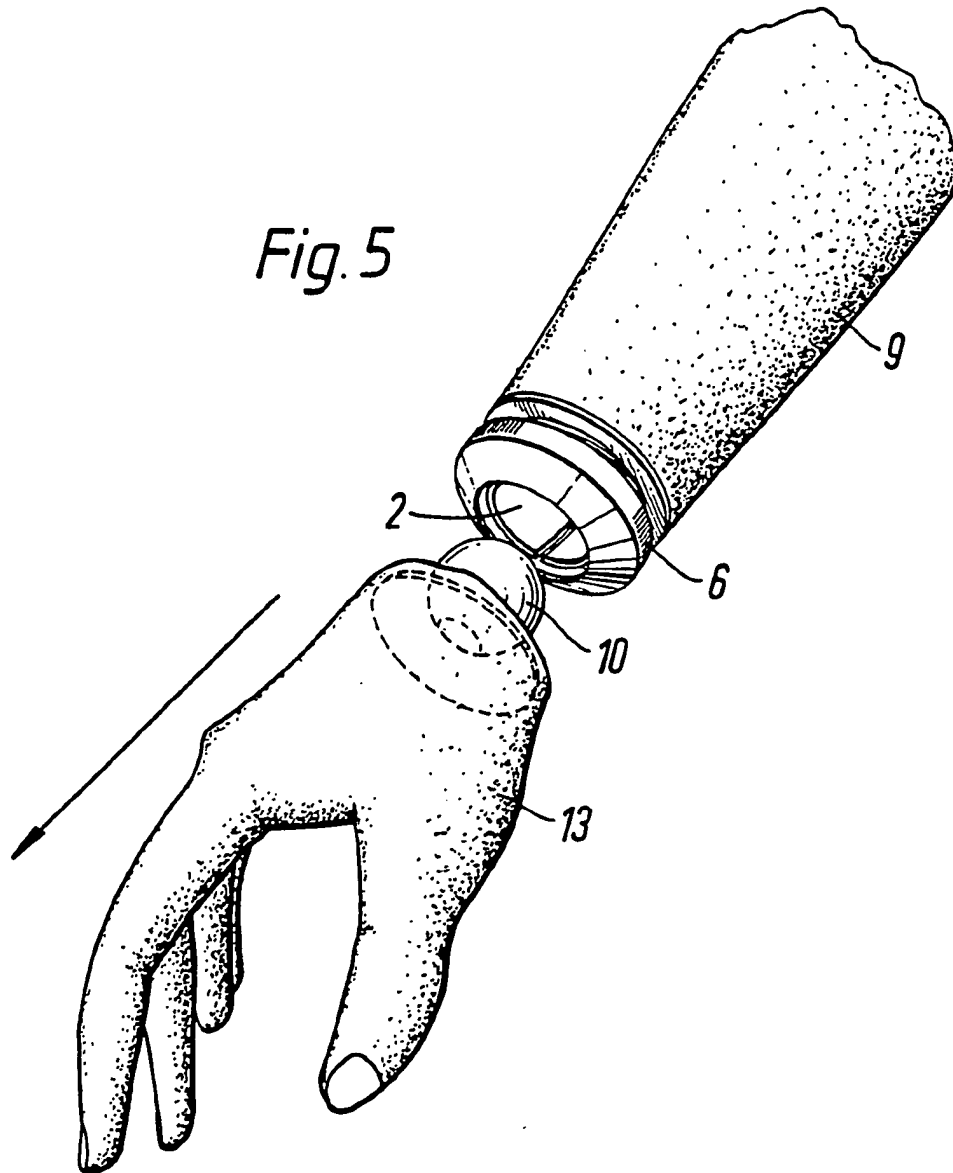


Fig. 4



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Fig. 5



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Fig. 6

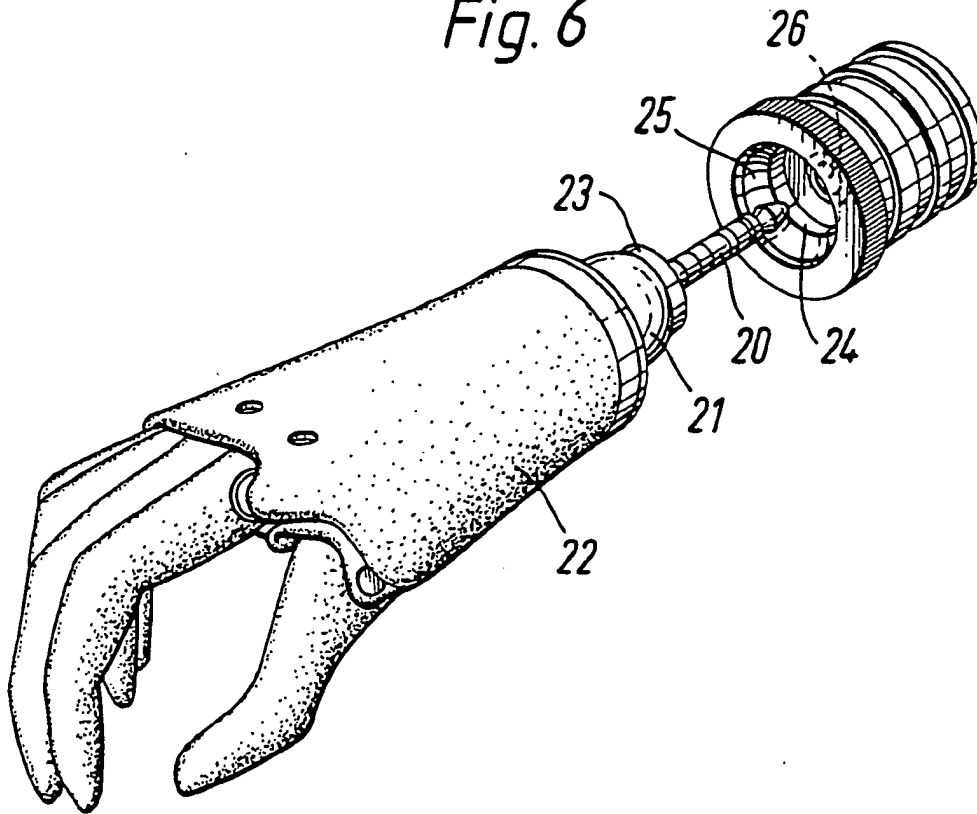
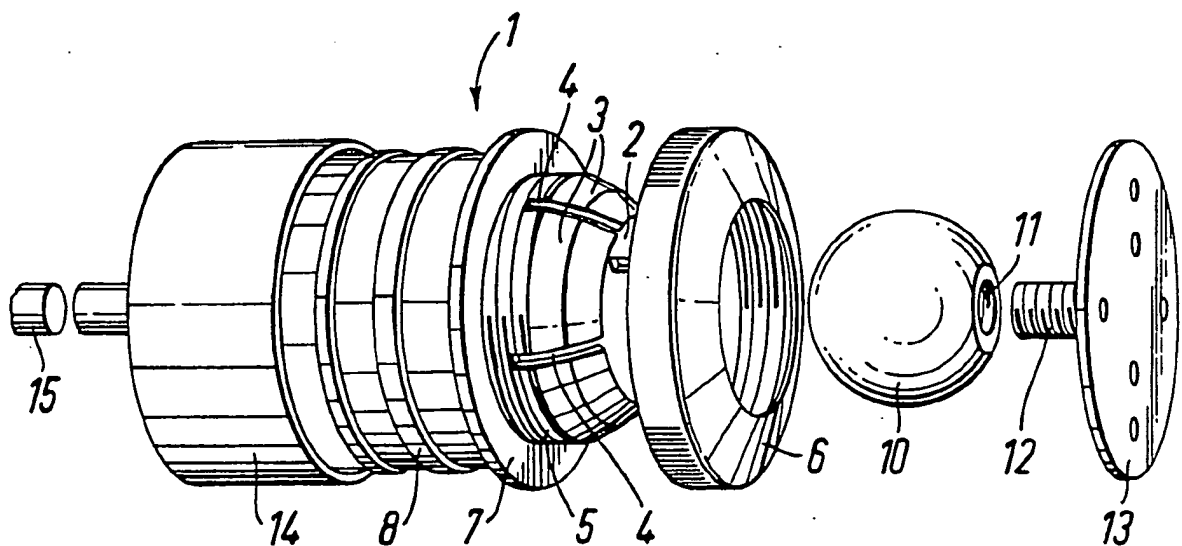


Fig. 7



## PROSTHETIC WRIST

### Field of the Invention

This invention relates to a prosthetic wrist for adjustably mounting and supporting a terminal device such as a prosthetic hand.

### Background to the Invention

It is desirable for a prosthetic wrist to be able closely to simulate the range of movements of a natural wrist. Other requirements for a prosthetic wrist are that the resistance to movement may be varied to suit different circumstances and the preference of the wearer, and that different terminal devices may be fitted readily for use in different tasks, for example. These different requirements have hitherto been in conflict with each other, with the result that the design of the wrist is necessarily a compromise.

### Summary of the Invention

According to the invention, there is provided a prosthetic wrist, comprising a ball and socket joint wherein the ball has means for attachment to a terminal device, for example a prosthetic hand, and the socket has means for attachment to an arm, the socket being formed of a resilient material and being shaped so that the ball is a snap fit thereinto, the wrist also comprising means for compressing the socket on to the ball whereby the friction between the ball and the socket may be progressively increased until the ball is locked therein.

Preferably, the socket comprises a plurality of resilient segments therearound, the segments being resiliently deflectable outwardly to admit or release the ball, and the means for compressing the socket being arranged to deflect the segments inwardly on to the ball to increase the friction thereon. The means for compressing the socket preferably comprises a ring screw-threaded on to the socket and bearing on the segments. The ring serves the additional purpose of holding the ball in the socket. Unscrewing the ring permits the ball to be snapped out of the socket, for example to permit replacement of the terminal device for a different function, or for repair.

The prosthetic wrist is suitably formed of a plastics material, for example a polyamide such as "Nylon" (RTM). It is thus lightweight and requires no lubrication.

The prosthetic wrist of the invention provides a full range of movement, including rotation, at the wrist junction. It is ideal for sporting activities such as golf, cricket and hockey, and indeed in any activity which requires a natural wrist movement. The friction in the wrist is easily adjusted, allowing variation in resistance to wrist movement, by unscrewing or tightening the ring. To permit removal of the terminal device, the ring is unscrewed and the ball, with the terminal device attached, is snapped out of the socket, to be replaced by another terminal device with its respective ball attached.

The wrist may be adapted to allow only rotation and disconnect functions, and a myoelectric rotation disconnect device, for example a socket to receive an electrical jack plug extending from the ball, may be incorporated to enable conversion from powered to conventional terminal device. The wrist may also be adapted for fitting to endoskeletal systems. Alternatively, the wrist may be adapted to be part of a traditional terminal device, with the terminal device being screwed directly into the ball.

#### Brief Description of the Drawings

In the drawings, which illustrate an example of a prosthetic wrist in accordance with one embodiment of the invention:

Figure 1 is a perspective view of the wrist;

Figure 2 is a side view, partially cut away to show the ball;

Figure 3 is an exploded perspective view of the wrist;

Figure 4 is a perspective view of the wrist with a terminal device fitted;

Figure 5 is a view corresponding to that of Figure 4, showing the removal of the terminal device with the ball;

Figure 6 is a perspective view of a myoelectric hand being fitted to a wrist in accordance with the invention; and

Figure 7 is a view corresponding to Figure 1, but showing the fitting of the wrist to an endoskeletal assembly.



Detailed Description of the Illustrated Embodiment

Referring to Figure 1, the prosthetic wrist comprises a moulded plastics body 1 having at one end thereof a socket 2 whose entrance is defined by four segments 3, each separated from the adjacent segments by longitudinal slits 4 permitting the segments 3 to flex inwardly and outwardly. The body 1 has a screw-threaded portion 5 receiving a screw-threaded locking ring 6 shaped to press on the segments 3 and to urge them inwardly as the ring 6 is screwed further on to the portion 5. A shoulder 7 separates the screw-threaded portion 5 from a circumferentially-ribbed portion 8 which receives a tubular fore-arm section 9 for fitting on to the remaining fore-arm of the wearer.

A plastics ball 10 fits into the socket 2, which is so shaped that the segments 3 have to flex outwardly to admit or release the ball. The ball 10 has a screw-threaded bore 11 therein for receiving a threaded stud 12 on a terminal plate 13 to which a terminal device may be secured. Alternatively, the ball and terminal plate 13 may be formed as a permanent one-piece unit.

Figures 2 and 3 shows the wrist assembled, with the ball held in the desired attitude by screwing the locking ring 6 further on to the body 1 to close the segments 3 on to the ball 10, increasing the friction between the ball and the socket 2 until the ball is locked in position (if desired).

Figure 4 illustrates the wrist as part of a prosthetic device including a hand 13. The arrows indicate the wide range of movements available with the wrist of the invention, the hand being movable up and down and from side to side, as well as being rotatable.

To permit the terminal device 13 to be exchanged, the ring 6 is unscrewed to allow the segments to be deflectable outwardly, and the ball 10 can then be pulled out of the socket by pulling on the prosthetic hand, as can be seen in Figure 5. The replacement terminal device, with its own ball attached, may then be fitted by pushing the ball into the socket and screwing down the ring 6 until the desired degree of friction is achieved between the ball and the socket.

Where the wrist of the invention is used with a myoelectric hand, as shown in Figure 6, a jack plug 20 extends from the ball 21 to provide the plurality of electrical connections required for control of the hand 22, and the ball is also provided with a short cylindrical shoulder 23, for example of 5mm length, which engages in a corresponding recess 24 in the socket 25. A jack socket 26 is provided in the socket 25 to receive the plug 20 and to make the electrical connections from the power source and switching sensors, which are located in the wrist/arm section in conventional manner. This arrangement does not permit angular movement of the wrist, but allows full rotation.

Figure 7 shows the fitting of the wrist to an endoskeletal system. The laminated exoskeletal forearm section indicated at 9 in Figure 1 is replaced by an adaptor 14 which fits over the circumferentially ribbed portion 8, and which receives the forearm tube 15 of a conventional endoskeletal assembly.

CLAIMS

1. A prosthetic wrist, comprising a ball and socket joint wherein the ball has means for attachment to a terminal device and the socket has means for attachment to an arm, the socket being formed of a resilient material and being shaped so that the ball is a snap fit thereinto, the wrist also comprising means for compressing the socket on to the ball whereby the friction between the ball and the socket may be progressively increased until the ball is locked therein.

2. A prosthetic wrist according to Claim 1, wherein the socket comprises a plurality of resilient segments therearound, the segments being resiliently deflectable outwardly to admit or release the ball, and the means for compressing the socket is arranged to deflect the segments inwardly on to the ball to increase the friction thereon.

3. A prosthetic wrist according to Claim 2, wherein the means for compressing the socket preferably comprises a ring screw-threaded on to the socket and bearing on the segments.

4. A prosthetic wrist according to any preceding claim, formed of a plastics material.

5. A prosthetic wrist according to Claim 4, wherein the plastics material is a polyamid .

6. A prosthetic wrist according to any preceding claim, incorporating a myoelectric rotation disconnect device.

7. A prosthetic wrist according to Claim 6, wherein the disconnect device comprises a socket to receive an electrical jack plug extending from the ball.

8. A prosthetic wrist according to any preceding claim, adapted for fitting to endoskeletal systems.

9. A prosthetic wrist according to any of Claims 1 to 5 wherein the terminal device is screwed directly into the ball.

10. A prosthetic wrist, substantially as described with reference to, or as shown in, the drawings.

**Patents Act 1977**  
**Examiner's report to the Comptroller under Section 17**  
**(the Search report)**

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**Relevant Technical Fields**

- (i) UK Cl (Ed.M) A5R (RFA)  
 (ii) Int Cl (Ed.5) A61F 2/54, 2/58

Search Examiner  
 Mr N Franklin

Date of completion of Search  
 10 August 1994

**Databases (see below)**

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE DATABASE : WPI

Documents considered relevant following a search in respect of Claims :-  
 1-10

**Categories of documents**

- |   |   |
|---|---|
| <b>X:</b> Document indicating lack of novelty or of inventive step.   | <b>P:</b> Document published on or after the declared priority date but before the filing date of the present application.        |
| <b>Y:</b> Document indicating lack of inventive step if combined with one or more other documents of the same category. | <b>E:</b> Patent document published on or after, but with priority date earlier than, the filing date of the present application. |
| <b>A:</b> Document indicating technological background and/or state of the art.   | <b>&amp;:</b> Member of the same patent family; corresponding document.   |

Category	Identity of document and relevant passages	Relevant to claim(s)
X	US 4613331 (UNIV OF UTAH) note column 1 lines 43-52	1 at least

**Databases:** The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).